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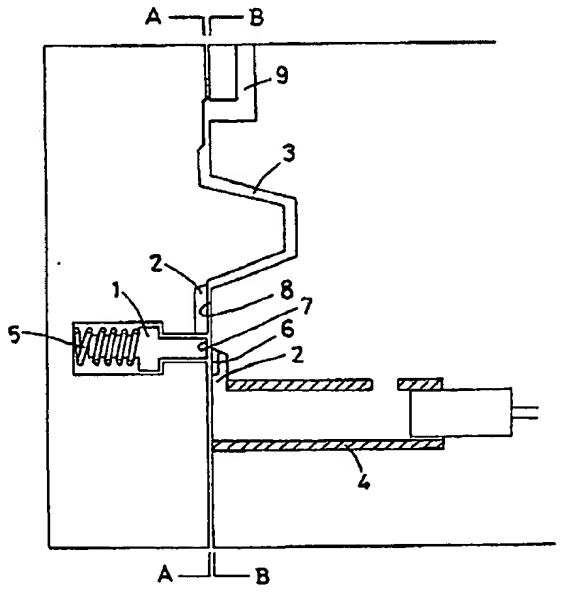
(54) Vacuum die casting process.

(57) A die casting process comprising the steps of disposing a boiling shutoff device (1) on a sprue runner (2) from a sleeve (4) to a cavity (3) and branching a degassing groove (6) from the sprue runner (2).

Fig.1



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VACUUM DIE CASTING PROCESS

BACKGROUND OF THE INVENTION

The present invention relates to a vacuum die casting process.

Hitherto, conventional techniques of die casting, in which amount of gas included in the die cast product is to be reduced, may be generally classified into two methods, i.e., massive-vent method in which resistance of degassing groove is increased so as to prevent blowout of molten metal, and quick-shaft method in which die is equipped with a vacuum valve and the valve is closed by inetia of molten metal injected at high speed. Between the mentioned two methods, research and development of the latter have more actively taken place in the art mainly because in the latter method cavity is continuously subject to vacuum suction so that the cavity is almost fully filled with molten metal and a valve is open up to the molten metal reaching the vacuum valve disposed on the top end of degassing section of the die, as is disclosed in Japanese Patent Publication (Examined) 58-46386.

In the vacuum casting according to the prior arts, however, there exists a serious problem in that, since the vacuum suction in the cavity and sleeve is carried out suddenly at high speed once molten metal is supplied into the sleeve thereby piston sleeve comeing to close the molten metal suppy port, a lubricating oil applied to inside the piston sleeve and in contact with the molten metal of high temperature comes to bump and mix with the molten metal due to sudden pressure drop, whereby hydrogen and carbon are produced as a result of decomposition due to high temperature of, for exasmple, 700° C. Once such produced hydrogen and carbon have mixed with the molten metal, it is substantially impossible to separate them even by vacuum suction. Thus, the hydrogen brings about undesirable micro-porosity, shrinkage cavity, wrinkle, cold-shut, expansion, blistering, etc., while cthe carbon makes the cast product blackened, i.e., dirty-looking. Moreover, when the piston sleeve is supplied with molten metal, the lubricating oil in the piston sleeve being in contact with the molten metal of high temperature comes to be vaporized (or gasified). The gas produced by the vaporization condenses itself when passing through the sprue runner and cavity. And with such condensed portion, the molten metal of high temperature reaching afterward comes in contact and is decomposed thereby producing a large mount of hydrogen, eventually resulting in the problem of micro-porosity.

SUMMARY OF THE INVENTION

The present invention was made to solve the above-discussed problems and has an object o f providing a die casting process in which generation of hydrogen, carbon, etc. in the piston sleeve, the cavity and sprue runner is restrained so as not to affect negatively the quality of cast product and to achieve a product completely free from micro-porosity.

In order to accomplish the foregoing object, the die casting process in accordance with the present invention comprises the steps of disposing a boiling shutoff device on a sprue runner from a sleeve to a cavity and branching a degassing groove from the sprue runner. It is preferable that a pin is employed as the mentioned boiling shutoff device, and that a gap for moderating differential pressure is provided in the degassing groove branched from the sprue runner. It is also preferable that the mentioned boiling shutoff device is a sprue runner which is meanderingly formed to serve as a resistance sprue runner. It is preferable that a basin is provided in place of the mentioned degassing groove branched from the sprue runner.

Since the boiling shutoff device disposed in the midway of the sprue runner interrupts communication between the cavity side and the sleeve side, lubricating oil in the sleeve is prevented from bumping due to sudden pressure drop by high vacuum, while the gas due to vaporization of lubricating oil generated as a result of contacting the molten metal of high temperature in the sleeve and the air existing in the sleeve before supplying the molten metal, are both discharged out of the die at low speed without passing throught the cavity.

Further, as a result of providing the gap for moderating differential pressure in the degassing groove, even if the groove portions on both cavity and degassing sides perform their suction at high vacuum, there occurs no such large pressure drop as to brings about bumping owing to the provision of the shallow gap for moderating differntial pressure.

Furthermore, when actuating the boiling shutoff device with pressure of molten metal coming from the sleeve and utilizing the advancing force thereby to turn ON a limit switch for high speed injection to carry out injec- tion at high speed, the molten metal of the highest probability of generating defective product due to inclusion of impurities and gases and which passes through the sleeve where gases produced by vaporization are condensed and through the sprue runner, advances laterally turning from around the end face the boiling shutoff

pin. Therefore, the sprue runner is filled with only the molten metal completely pure and clean which comes afterward, and pressure generated thereby pushes up the boiling shutoff pin against a spring, finally actuating the limit switch for high speed injection through an inclined surface and sliding plates.

Moreover, since the boiling shutoff pin interrupts passage between the sprue runner and the cavity simultaneously with closing operation in the cavity, vaccum suction can be started immediately upon the closing, which means that there is enough time for the vacuum suction to increase degree of vacuum.

In case that the boiling shutoff device is a resistance sprue runner meanderingly disposed, vacuum suction may be carried out to the extent of not causing bumping in the vaccum system of low degree on the molten metal introducing side of the resistance sprue runner until the molten metal reaches the middle part on the resistance sprue runner. The injection piston moving forward at low speed is stopped upon reaching the molten metal as mentioned. and at the same time the vacuum system of high vacuum degree on the cavity side and a timer for controlling vacuum time are put into operation. High injection is carried out after accomplishing complete vacuum state in the sprue runner and cavity.

In effect, since the boiling shutoff device provided on the way of the sprue runner performs interruption between the cavity side and the sleeve side, lubricating oil in the sleeve may be prevented from bumping due to sharp pressure drop by sudden occurrence of high vacuum. The gas generated by vaporization of lubricating oil due to contact with molten metal of high temperature in the sleeve and the air existing before supplying the molten metal in the sleeve can be exactly discharged out of the die through the degassing groove of low speed without passing through the cavity. As a result of this, the inner part of the cavity is kept clean and this clean cavity is filled with pure molten metal without containing impurity gas, thus a perfect product without micro-porosity being obtained.

In addition, the invention is applicable not only to die casting but also to other casting to xhibit the foregoing advantages.

Other objects and advantages of the invention will become apparent in the course of the following description with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings forming a part of the present application, and in which like reference numerals are designated to like parts throughout the same:

Figure 1 is a partially cut out longitudinal sectional front view illustrating the vacuum die casting process in accordance with the invention;

Figure 2 is a side view illustrating the movable die taking along the line A-A of Figure 1;

Figure 3 is a side view illustrating the stationary die taking along the line B-B of Figure 1;

Figure 4 is a longitudinal sectional view illustrating the gap for moderating differential pressure provided on the degassing groove;

Figure 5 is a side view of the stationary die illustrating the gap for moderating differential pressure provided on the degassing groove;

Figure 6 is a partially enlarged longitudinal sectional view illustrating the gap for moderating differential pressure provided in the degassing groove;

Figure 7 is a longitudinal sectional view illustrating the detector for detecting movement due to pressure;

Figure 8 is a side view of the movable die in which boiling shutoff device is formed into a resistance sprue runner;

Figure 9 is a side view of the movable die in which molten metal basin is provided in substitution for the degas sing groove; and

Figure 10 is a partially enlarged longitudinal sectional view illustrating the molten metal basin.

DESCRIPTION OF THE PREFERRED EMBODIMENT

An embodiment in accordance with the present invention is now described with reference to the accompanying drawings. Referring to Figures 1 to 3, the boiling shutoff pin 1 is provided between the cavity 3 and the sleeve 4 of the sprue runner 2. This boiling shutoff pin 1 is inserted in such a manner as to be freely slidable perpendicularly to the mating surface 8. The degassing groove 6 is provided to normally close the sprue runner with an impetus given by the spring 5. In the degassing groove 6, almost half of a circular end face 7 of the mentioned boiling shutoff pin 1 may come in contact with the mating face 8 for closing, and through such a half closing position, the degassing groove 6 communicates with the sprue runner 2, then is turned to advance laterally. On the other hand, for concavely providing the degassing groove 9 for high vacuum suction, one end is guided out of the die while the other end communicating with the cavity 3.

Referring to Figures 4 to 6, the gap 10 for moderating differential pressure is formed in such a manner that a part of the degassing groove 6 branched from the sprue runner 2, that is, the

bottom side may be higher.

Referring now to Figure 7, for providing the detector 12 for detecting movement by pressure, one of a pair of sliding plates 14, 14, whose inclined surface 13 at end portion slides obliquely, is fixed to the boiling shutoff pin 1, while the other being inserted in the die so as to be freely slidable and with which the limit switch 15 for high speed injection is in contact for detection.

Referring to Figure 8, the resistance sprue runner 16 is provided to the mating surface in such a maner as to be meander between the sleeve 4 and the cavity 3. More specifically, the degassing groove 6 is provided laterally from the end of the sleeve of the resistance sprue runner 16, and it is preferable that a switch (not illustrated) also serving as changeover from low speed to high speed is provided so that movement of the molten metal may be temporarily stopped in the resistance sprue runner 6 without fail.

Referring to Figures 9 and 10, the molten metal basin 17 is concavely provided laterally from the position of the mating face with which the end of the boiling shutoff pin 1 comes in contact.

It is further understood by those skilled in the art that the foregoing description is a preferred embodiment of the disclosed device and that various changes and modifications may be made without departing from the spirit and scope of the invention.

The features disclosed in the foregoing description, in the claims and/or in the accompanying drawings may, both separately and in any combination thereof, be material for realising the invention in diverse forms thereof.

Claims

1. A die casting process comprising the steps of disposing a boiling shutoff device on a sprue runner from a sleeve to a cavity and branching a degassing groove from the sprue runner.

2. A die casting process according to claim 1, wherein a pin to which impetus is given by spring pressure is employed as the mentioned boiling shutoff device.

3. A die casting process according to claim 1, wherein a gap for moderating differential pressure is provided in the degassing groove branched from the sprue runner.

4. A die casting process according to claim 1, wherein the boiling shuoff device is operated by molten metal pressure from the sleeve, and with a force for this operation a limit switch for high speed injection is operated to carry out injection at high speed.

5. A die casting process according to claim 1, wherein the boiling shutoff device is a sprue runner which is meanderingly formed to serve as a resistance sprue runner.

6. A die casting process according to claim 1, wherein a basin is provided in place of the degassing groove.

Fig.1

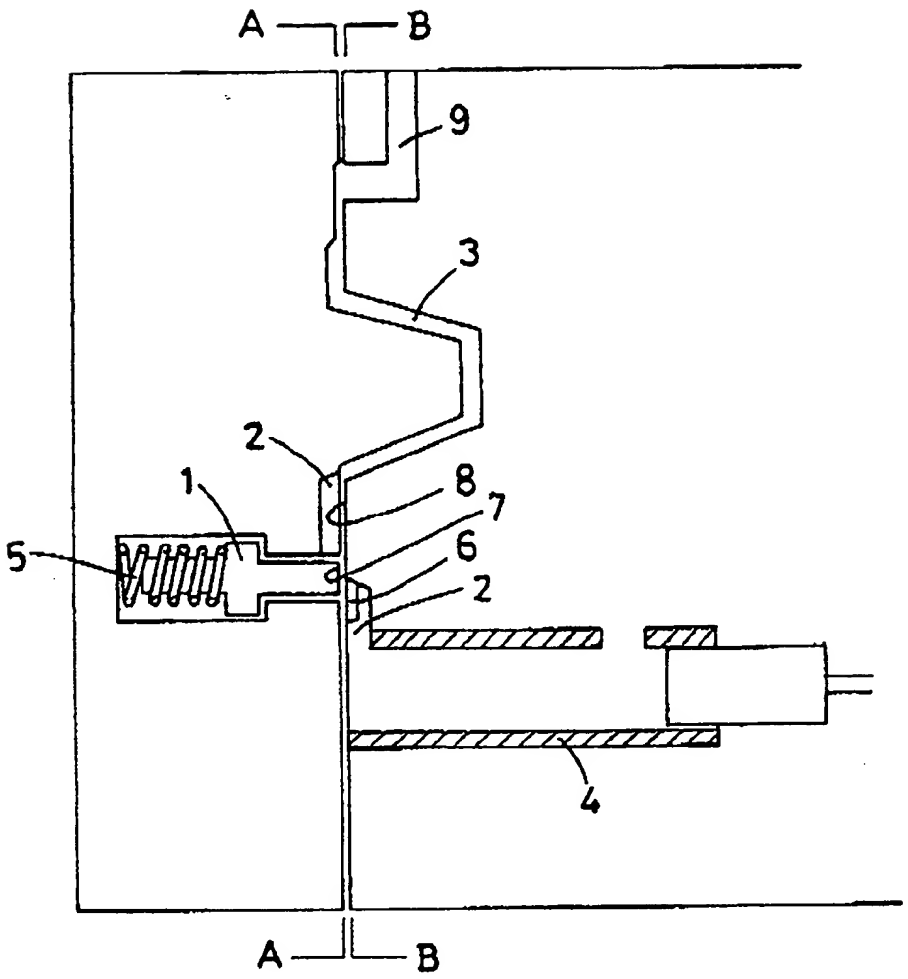


Fig. 2

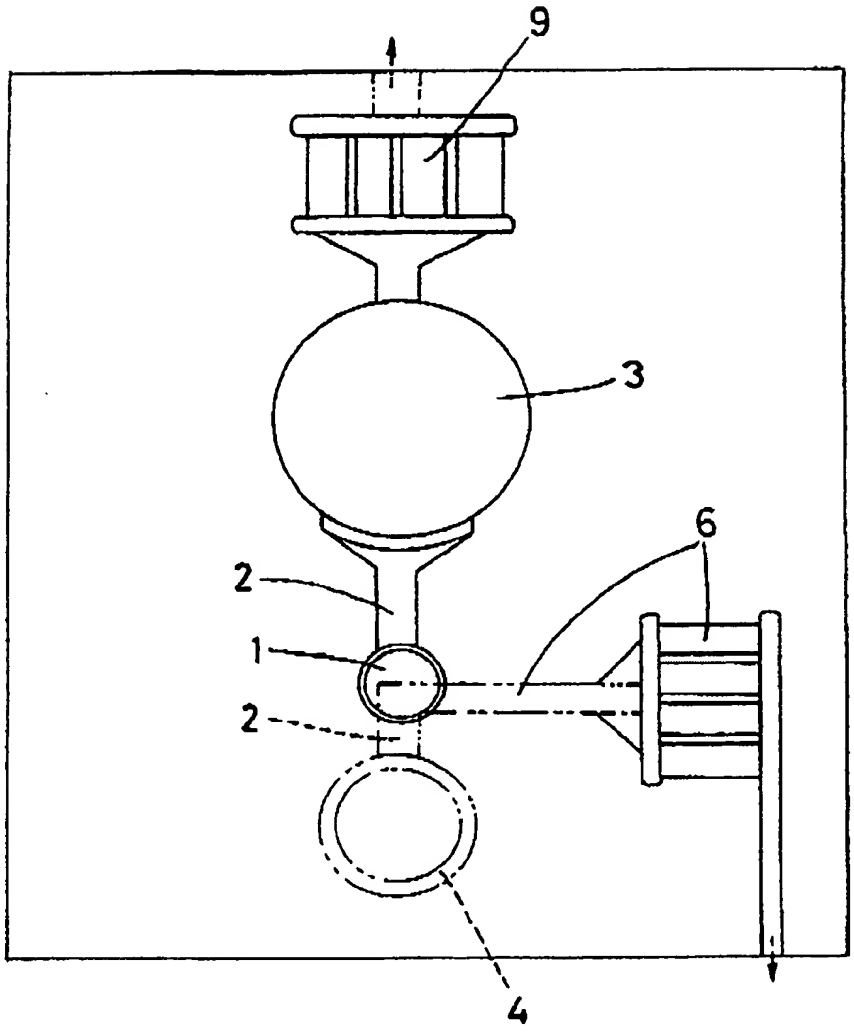


Fig.3

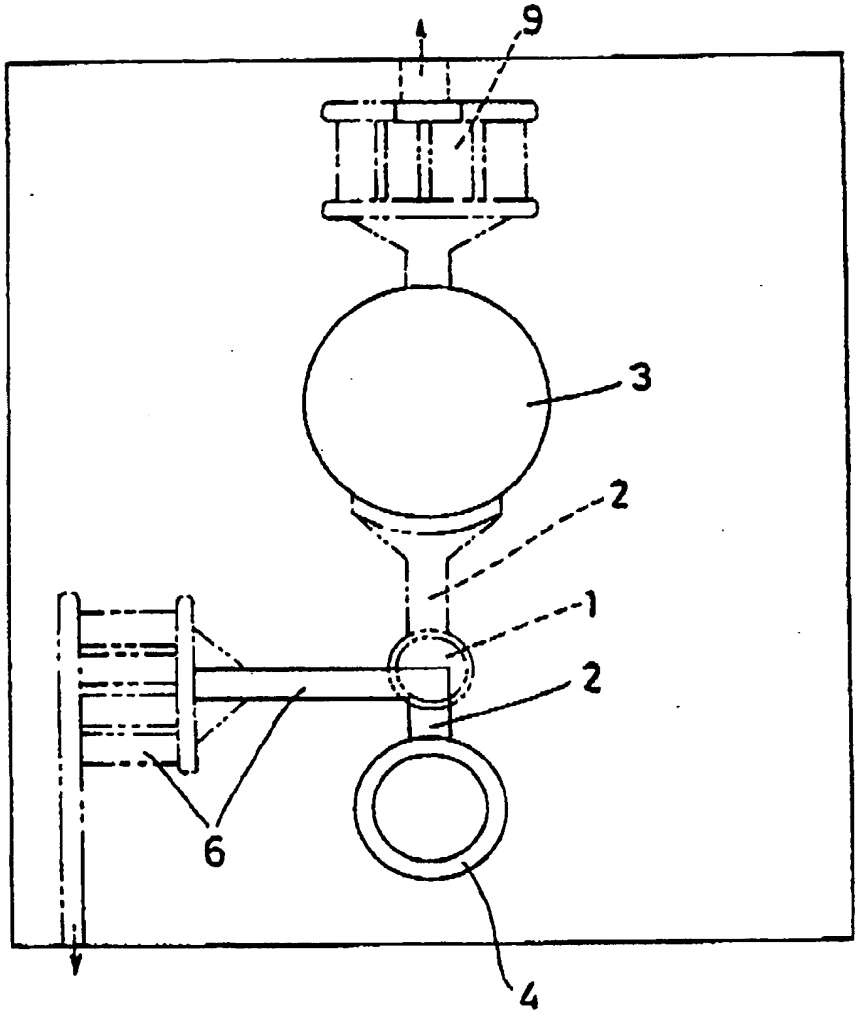


Fig.4

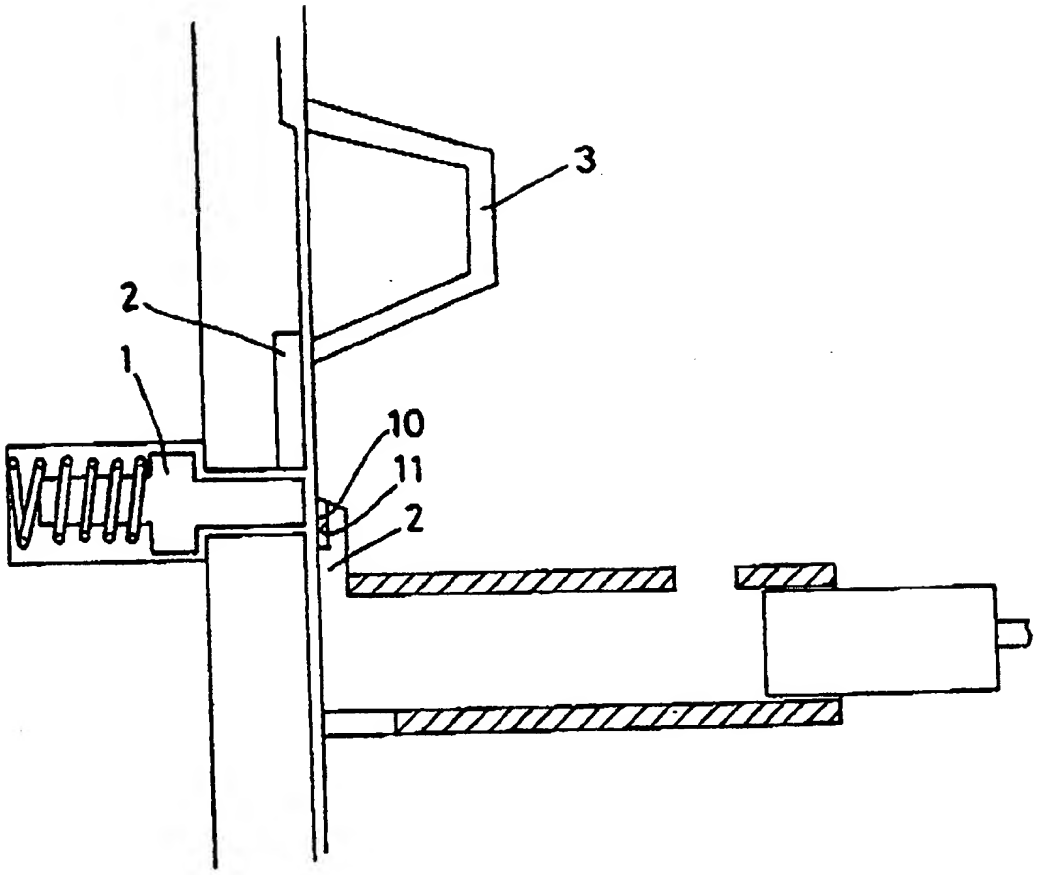


Fig.5

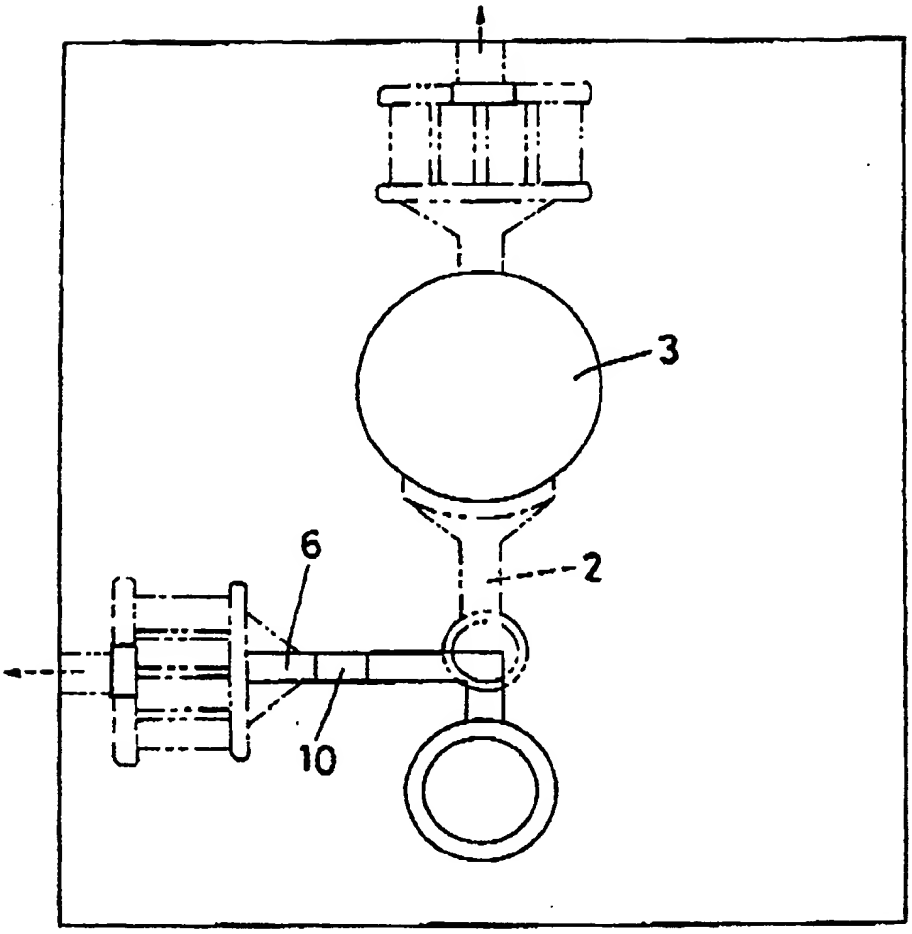


Fig.6

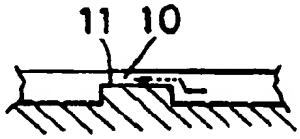


Fig.7

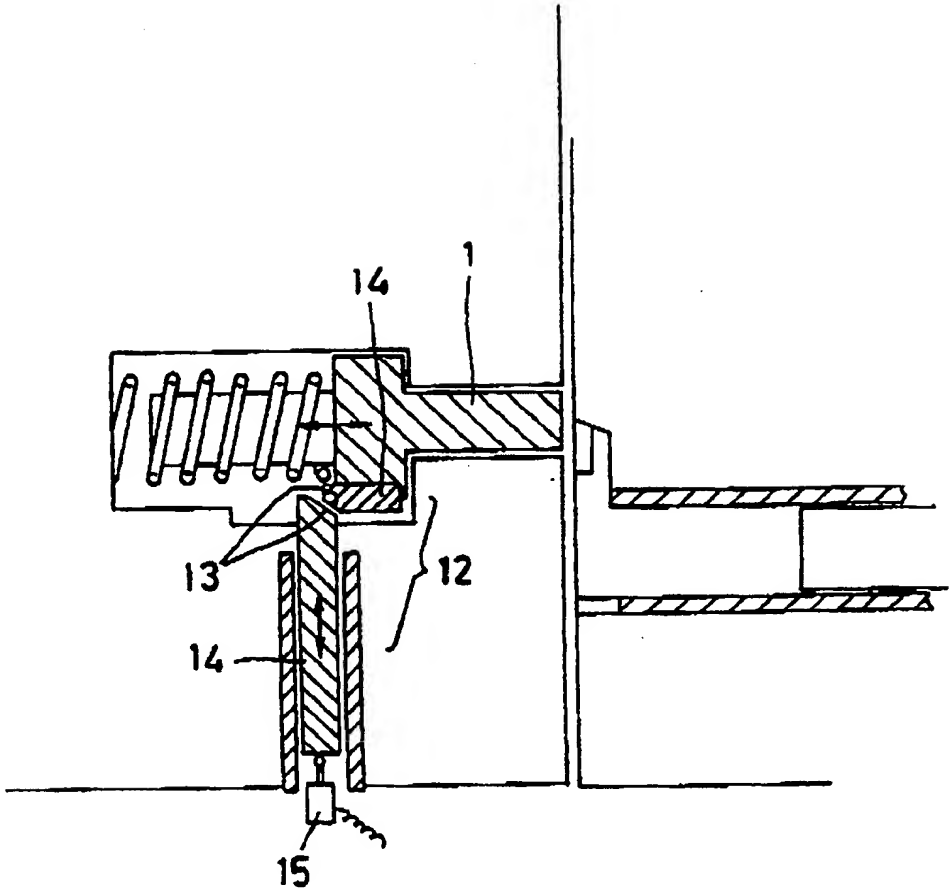


Fig.8

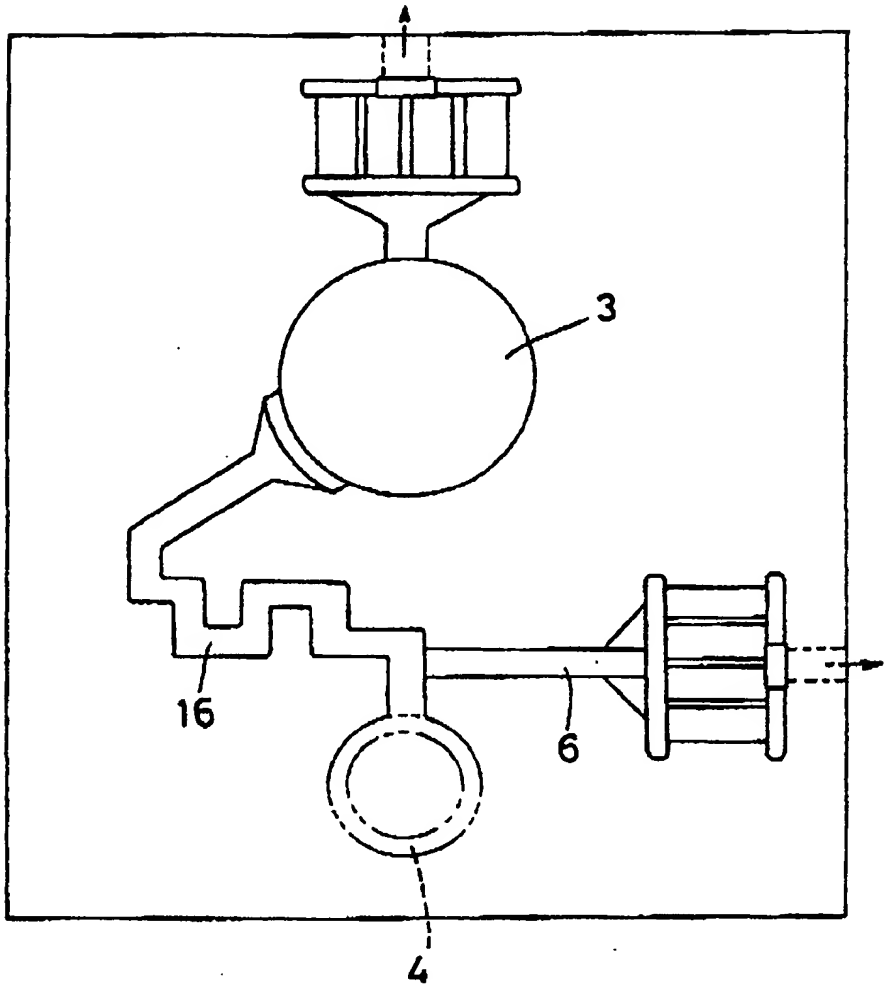


Fig.9

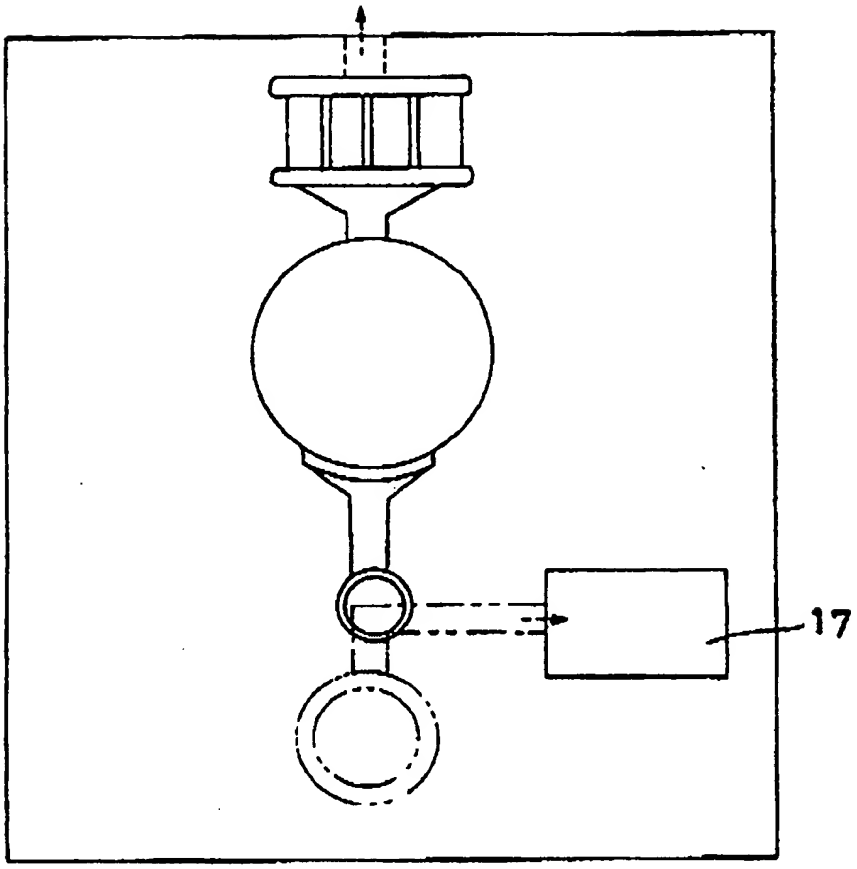
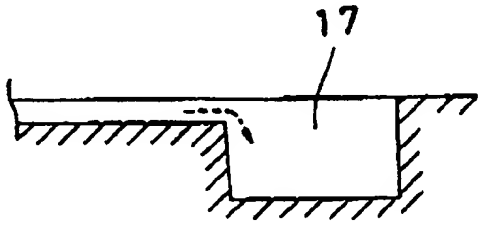


Fig.10



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EUROPEAN SEARCH REPORT

Application Number

EP 91 10 1449

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	EP-A-0 275 426 (VEREINIGTE ALUMINIUMWERKE) * Column 1, lines 9-36; column 3, lines 9-23; column 4, lines 7-30; figures 1-2 *	1-6	B 22 D 17/14
Y	FR-A-1 133 548 (FRITZ HODLER) * Page 4; figures *	1-2,4	
Y	EP-A-0 241 426 (SCHWEIZERISCHE ALUMINIUM AG) * Figure 1 *	1,3	
Y	US-A-3 121 926 (G.R. MORTON) * Column 2, lines 5-49; column 3, lines 45-65; column 4, lines 16-19; figures 1-2 *	1,3-6	
A	CH-A-4 543 69 (GEBRÜDER BÜHLER AG) * Subclaims 7,8; figure *	2	
A	FR-A-1 416 039 (FRITZ HODLER) * Pages 6-7; abstract; figures *	1-4	
A	FR-A-1 001 767 (MARC IEL) * Figure *	6	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 22 D

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	18 April 91	BOMBEKE M.J.P.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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A: technological background
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D: document cited in the application
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